

GALEN
ON THE
HAND.
BELLLOT

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By Thomas Bellot & Joseph Jordan

Galer





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GALEN

ON THE

HAND.



The Rev. W. B. Savies M. A.
"Bicar of Radford" Lemele
with the very sincere respect and kind
regard of
Wm Henry Bellot, M. D. & F. R. C. S. &c
late 1st Lt. - Devonshire Militia. May 1868

THIS IS INSCRIBED

AS A SMALL TOKEN OF RESPECT,

TO

SIR WILLIAM BURNETT, KNT., M.D., K.C.H.

INSPECTOR GENERAL OF FLEETS AND HOSPITALS,

By his

OBEDIENT HUMBLE SERVANT,

THE AUTHOR.

Thomas Bellot, F. R. C. S. Royal Navy,
late Surgeon H. M. Flag Ship Britannia
Black Sea, in "Crimean War," also to the
R. G. Naval Hospital "Therapia," &c on. —
Author of "Sanskrit derivations of English words"
dedicated by permission to R. Hon. the Earl of Ellesmere
Served in "East" "West Indies," "Coast of Africa"
"China" "Black Sea" &c on — also
appointed Surgeon "second Royal Devonshire Militia"

GALEN ON THE HAND.

Each animal is separated by its proper boundary, and not at all united to any other creature ; so also with regard to the organs of an animal, as the eye, the nose, the tongue, and the brain, each have ~~their~~ ^{its} proper circumscription. If they be not connected to adjoining parts, but altogether separated, then they would not be a part, but a whole. Therefore, those bodies which are not altogether circumscribed, nor in all parts joined with others, these have been named parts. If this be true, many parts make the whole animal, some large, some small. All these parts are necessary for the mind, for the body is the organ of the mind,—on this account, the parts are as various, as the minds : some are bold, some are timid, some wild, some tame, some gregarious, some solitary. All animals have bodies adapted to their minds.* The horse has hard hoofs, and is adorned with a mane, for he is swift, proud, and bold. The lion, powerful and ferocious, is armed with teeth and claws. Thus also the bull, and the boar, to the one horns, to the other tusks have been assigned. To the stag

* Vide Anacreon, Ode 2nd.

and the hare, (for they are both timid,) swiftness is given ; their bodies being defenceless and unarmed. For I think, swiftness was the best for the timid, and arms for the bold. Therefore, nature has neither given arms to the timid, nor has she left the bold unarmed. But to man, because he is a wise animal, and the only one divine on earth, for all defensive weapons, she has given the hand, an organ suited for all arts, no less for peace than for war. He is not born armed with horns, since, when he wishes, he can grasp better instruments ; for swords and darts are better weapons, than horns and hoofs. Nor has she, indeed, left him without hoofs ; for stone and wood inflict more dangerous injuries than hoofs. Neither horns nor hoofs can act, unless at close quarters ; but the weapons of man take effect, no less at a distance, than hand to hand. Darts and arrows are superior to horns ; and wood and stone are superior to hoofs. But the lion is swifter than man—what then ? Man rules the horse, an animal much swifter than the lion, with his wisdom and his hands ; mounted on the horse, he evades and pursues the lion ; sitting on high, he strikes it beneath his feet. He is, therefore, neither defenceless nor unarmed ; nor is he easily wounded ; nor are even his feet unprotected : when necessary, he puts on a breastplate of iron, more impenetrable than any hide. Not the breastplate only, but houses, and

walls, and castles, are all works of safety for man. If horns, or any other defensive weapon, had been placed by nature in his hand, he could not then have used his hands, to construct houses, erect forts, or forge a spear or breastplate, or other instruments. With his hands he makes his dress, forms nets, traps for fish, and arrows, and sails, so that man not only rules the animals of the land, but of the sea, and of the air. Such mighty instruments are the hands of man. But man is a peaceable, as well as a warlike animal. With his hands he has written laws, erected altars and statues to the gods, and built ships, and made lyres, and knives, and pincers, and all the instruments of art, and left us the descriptions of them, and also gives you, by the hand-writing, the means of conversing with Plato, with Aristotle, with Hippocrates, and others of the ancients. Man is the wisest of all animals, and hands are proper for so wise an animal. Not because he has a hand is he the wisest animal, as Anaxagoras said; but because he is the wisest animal he has a hand, as most truly Aristotle says. For the hands instruct not man in arts, but reason. The hands are organs, as the lyre to the musician, or the forceps to the artist. But the lyre does not teach music, nor the forceps arts, but there is an artificer for each, who is endowed with reason, but he could not work without instruments. And thus each mind possesses certain faculties from its

own peculiar essence ; but the mind is unable to effect those things which it was created to perform, without organs. But that the organs of the body do not make the mind bold, nor timid, nor wise, will be manifested, if you consider animals newly born, attempting to act as if they had perfect organs : for I have often seen the young bull butting before the horns appeared, and the colt striking with its soft hoof ; and the young boar endeavouring to defend itself with its jaws, yet destitute of its mighty tusks ; and the new born puppy trying to bite with its covered teeth. Every animal foreknows by instinct, without instruction, its own faculties, and for what uses their organs are most fitted. Wherefore, how is it possible to say, that animals are taught the use of organs, by the organs themselves ? when it appears they know their use before they have them. If you should take three eggs, the one of an eagle, one of a duck, and a third of a serpent, and preserve them with a moderate heat, they will burst their shells, and leave them ; the young birds will try to fly with imperfect wings ; the other will hasten to bury itself in the earth, although yet soft and weak. If you nourish them, and keep them in the same room till they are full grown, then take and place them in the open air, and give them liberty, the eagle will soar aloft, the duck will fly to the nearest water, the serpent will glide and hide itself in the earth : this, I

think, comes without teaching—the one swims, the other hides itself in the earth. Hippocrates says, the dispositions of animals are untaught. This appears to me to be the state, that animals perform their work by instinct, rather than by instruction. The bees form their cells, and store the honey; the ants form their labyrinths, and collect their treasures; the spiders form their webs, as I can bear witness, without instruction. But man, as his body is destitute of arms, so his mind is destitute of arts; and for this defenceless state of the body, he has the hand; and in place of the untaught state of the mind, he has reason: by the use of these he arms the body, and preserves it in every way; and ornaments his mind with all arts. If he had been endowed with any weapons by nature, he would have possessed that only instead of all. So had he been born with knowledge of any one art, he would not have been able to learn any other. And since it was better for him to use all weapons and all arts, he is not by nature endowed with any. Therefore, beautifully has Aristotle said, the hand is an instrument, in place of all other instruments. And beautifully, some imitating Aristotle have said, reason was given in place of all arts. For as the hand is not an instrument for any special purpose, because it can well perform the duties of all: it is an instrument for all instruments. So with reason, it is

"The ancient Philosophers and Physiologists held that the only active principle in our body is mind and that the corporeal organs are the instruments by which it performs its operations. It was for mind that the great artificer Διὸς οὐρανός constructed the fabric of our body and by mind that the body preserves its organization during life."
"Brit. Medical Review"

assigned for no particular art ; but as occasion requires, it can receive them all, from which it is superior to all arts. Man is the only animal, who for arts has reason, and possesses the best right to the hand, which is an instrument for all instruments. We must now examine, not whether it be simply useful and convenient to a wise animal, but whether it be that form which could not possibly be better. If it can, in the first place, seize with facility all forms and all magnitudes. Whether it is better, for this purpose, it should be divided into many parts, or it should be solid, and not divided. If it had remained undivided, it would have comprehended only so much of a body, as equals the size of the undivided hand ; but divided into many parts, it easily seizes bodies of a much larger size, and small bodies it finds and collects. The hand, when extended to large bodies, seizes them with separated fingers. Those which are very small, it endeavours to seize with the tips of the finger and thumb, not with the whole hand, for then they would easily slip away and escape. This form is, therefore, best for seizing either large or small bodies. As it was the best to be divided, it must be so divided as it now is, as to seize bodies of all forms. It appears to be the best constructed of all prehensile organs. Forasmuch as the hand can form a circle round a sphere, grasping it on every side, it also as securely and firmly holds the

straight and concave ; which, if it be so, it can grasp all forms, for they are all formed from three figures, convex, concave, and straight. But since many bodies are too bulky for one hand, nature has given a second, an auxiliary to the other : that each grasping opposite sides, should not hold it less securely than one very large hand. For this reason they are placed opposite each other, (for they are formed for mutual use) and are in every respect equal : for they are the same organs, and have similar duties. Consider the largest body a man can grasp with both hands, as a tree, or a stone ; and again, the smallest thing perceptible, as a grain, a hair, or a thorn ; and then how great a number of bodies intervening between the largest and the smallest ; you will find man grasping all these, as if the hand had been formed for each. Man seizes the least bodies with the tips of two fingers, the index and the thumb, (which we Greeks call *megan*,) and bodies a little larger with the thumb and the same finger, but not with the tips ; for bodies still larger he employs three, viz., the fore, the middle, and the thumb ; and if the body be still greater, he uses three fingers and the thumb, then all four with the thumb ; afterwards he seizes with the whole hand ; and finally he seizes with both hands. It would have been impossible to perform any of these actions, if the hand had not been divided into variously formed fingers.

Nor is it sufficient they should be simply divided ; for suppose the thumb had not been placed opposite the four fingers, but all five placed in the same line, is it not plain the number would have been useless? For to grasp securely, it is necessary either that the whole body be encircled on every side, or wholly grasped on the two opposite sides. This power could not have existed, if all the fingers had been placed in the same straight line. This is all gained by the thumb being placed opposite the fingers ; which indeed, is so constituted, by virtue of its position, and freedom of motion, that, when slightly bent, it can act in conjunction with each of the four opposing fingers. As these actions of the hand were the best for man, nature has made it of that construction, best for these actions. It was necessary, not only that the finger and thumb should be opposite, in taking up small bodies, to act with their very tips, but it was necessary they should be, as they now are, soft, round, and armed with nails ; for, if the tips of the fingers had not been composed of flesh, but of bone, they could neither seize minute bodies, as hairs or thorns ; nor indeed, if of flesh, but of flesh modified to a softer and more pulpy nature ; for that which is taken up, must first be exactly surrounded by that which seizes it. But bone cannot be thus bent, but that which is rather soft, and, on that account, moderately yielding. Had the fingers been excessively

soft, like ropes, yielding more than necessary to hard bodies, they would easily slip away from them. So nature makes them between excessive softness, and extreme hardness, wherefore, those parts, whose structure is between excessive hardness, and extreme softness, as the tips of the fingers, will be organs best capable of seizing firmly. And the substances submitted to our grasp, consist of various forms and of various degrees of density, some softer, others harder; and nature has formed the fingers suitable for every variety. For the ends of the fingers are not made of horn alone, nor of flesh alone but composed of both, which form the best structure; for the fleshy part of them is placed on the internal surfaces, which are inclined to, and have their aspects towards each other; with the tips of which they search for objects. The nail is placed externally, to give firmness and support. The fingers, by their fleshy parts alone, seize soft bodies; but hard bodies they could not, from the yielding nature of the flesh, without the support of the nails: for with ^{over} the support of the nails, the flesh would yield, and be bent back. Since the nails are hard, they readily slip and glide away from hard bodies, and accordingly, the fleshy cushion at the ends of the fingers corrects the gliding and the slipping of the nails, and the nails, in their turn, prevent the turning back and yielding of the flesh; and thus the fingers can seize both small and hard

bodies : which, I say, you may clearly learn, if you look at nails which are too short or too long. For those which are immoderately long,—and therefore strike against and overlap each other in meeting,—can seize neither a small thorn, nor a hair, nor anything similar. But those which, from shortness, do not reach the ends of the fingers, by depriving the fleshy part of its support, render it less capable of prehension. Those which are equal with the summits of the fingers, are the most useful, and fulfil most perfectly the intentions for which they were formed. From which Hippocrates said, the nails should neither be longer nor shorter than the tops of the fingers ; for they do those things best for which they were designed, when they are of a moderate length. There are many other useful actions performed by them—to scrape, to scratch, or to skin, or tear into pieces. For in all acts, and in those especially in which accuracy of the hand is necessary, (which are called by Greeks, *Cheirurgiai*) all these actions are indispensable. That as the hand is the organ of prehension, so in finding and collecting small hard bodies, the nails are chiefly necessary. Why, therefore, has Plato, who borrowed many dogmata from Hippocrates, spoken so negligently concerning the use of the nails ? Why has Aristotle, who was most wise in speaking on other subjects, as well as on the art of nature, been so blind about the use of

the nails ? Aristotle writes, they were formed for defence, but he does not state if the defence was from heat, from cold, from wounds, or from bruises. But truly he could not think they were made for defence against these, and not for defence against other injuries. I have stated these opinions of Plato and of Aristotle, not that I should ill-naturedly find fault with their opinions, but I was urged to give their sentiments that I might be more clearly understood. As there was much difference of opinion, both amongst medical men and philosophers, on the uses of organs ; some thought our bodies were formed without intention, and without art ; others, that they were formed with reason and with art : but these differed greatly amongst themselves on the uses of the organs. Therefore, in the first place, I have endeavoured to find out a criterion between such various opinions, and secondly to find out some universal plan, by which we find out the use of each organ. Therefore, since Hippocrates has said, in the union of the organs of the whole body (which they call *oulomelia*) that all organs sympathize and harmonize with each other ; but that the smaller parts of each organ combine in its action. It appeared to me to be proper to examine this description, first in those parts, the action of which is evident to us. If I should first explain the description of Hippocrates, which is too obscure in many parts, from the old and brief manner

in which he has expressed himself, I shall describe the manner I have adopted in their examination. What he states is this, all the smaller parts of the body sympathize with each other; that is, all agree in doing service to, and in aiding, one action. The large parts of the whole have been formed for the sake of the actions of the entire animal, and all of them, together, agree and combine in these actions. But the smaller of these large parts, already called particles (smaller parts) are combined in the action of an entire organ; even as the eye, the visual organ, which consists of many particles, (small parts) all which it possesses agreeing in one action, namely vision. For the eye possesses some parts by which we see; some parts without which we could not see; others by means of which we see better; and other parts necessary for the health and preservation of all these parts. And every other part is constituted in the same manner, as the stomach, the mouth, the tongue, the feet, and the hands, that are now under discussion, concerning the action of which, no one is ignorant; for it is evident that they were made for prehension, because all of their particles are of such a construction, as to combine in one action of the entire organ; this all persons do not yet know. However, Hippocrates was acquainted with this, and we now propose to explain this very circumstance. That is to say, of what the method of finding out the uses of parts con-

sists, and also the method by which the errors of those who conjecture any thing at variance with truth are confuted. Moreover, even as the action of the eyes, of the hands and feet, is evident to all, and thus also the function of the chest, lungs and heart, and of all other organs, is very clear, we may not very much differ in these respects, as to what pertains to the use of the parts. But at present, because the action of very many parts is obscure, and we cannot find out the use of any part particularly, unless we are accurately acquainted with its action. It is evident, that all those have been mistaken concerning the use of parts, who have fallen into error concerning the functions of the organs. Since, therefore, neither Aristotle, nor any of his predecessors has described all the functions of organs, it was proper for us to have undertaken this work on the uses of the particles, (smaller parts.) Besides this, there are some, although they have described correctly the action of very many parts, yet, because they were inexperienced in finding out their uses, have been deceived in many particulars, as we have just shown concerning the nails; concerning the uses of which, even the best philosophers have appeared ignorant; nor have they understood the sayings of Hippocrates, (as we have observed.) Therefore, since on the hand, although we may know its action, however, we want, as yet, some

method for the finding out of its uses. Shall we then readily find out the beneficial uses of each of the parts of the brain, the heart, or of almost all the other viscera? Forasmuch as one, (author,) has placed the principle, (the seat*) of the soul in the heart, another in the membranes of the brain, (which the Greeks call meninges,) a third in the brain; wherefore, also a fourth will adduce another beneficial use of the particles, therein contained. But we will carefully investigate these, in the following books; for we have not, at this time, mentioned them for any other reason, than to explain the reasons, which, having adduced, why we have undertaken to write this work on the use of parts: especially since Aristotle has written so much, and so correctly. And besides him, others, not a few, medical men, as well as philosophers, have handed down to posterity, perhaps, fewer writings than Aristotle, but, nevertheless, true; amongst whom, indeed, is Herophilus, the Carthaginian. But the writings that Hippocrates has left us, do not suffice, because he has written some obscurely, others he has entirely omitted. However none of his writings are incorrect, if I am any judge. Therefore, by all these reasons, we have been actuated to write concerning the use of each particle; to proceed to explain some of the too obscure sayings of Hippocrates, and also to add

* Which the Greeks name hegemonous.

others, according to the methods handed down to us by him. Let us, therefore, return to the place from whence we digressed, and pursue our discourse concerning the whole constitution of the hand; for if we have been well versed in works concerning that construction, we should know, certainly, the action with the construction. Therefore, let us begin with the words of Hippocrates, as if the voice of a god: for in the passage in which he demonstrates the use of the nails, where he shows how large it was suitable for them to be; in that very place, likewise, he equally demonstrates in these words, the reason why the hand has been divided into fingers, and why the thumb is placed in opposition to the four fingers. “The faultless construction, and the excellent disposition of the fingers, (which he calls *euphüia*,) is, that that finger should be long which is in the middle, and that the thumb be set in opposition to the index finger. For the division of the fingers was made, that they might be separated as far as possible from each other, which arrangement is altogether the most useful; therefore, he suitably observes, that when any property is present in organs, on account of which they have been formed, that a construction of this kind, is by far the most suitable; certainly, according to which construction, the thumb has been placed in opposition to the fingers. But if the hand had only been thus

divided, notwithstanding, the thumb would not have been very far distant from the fingers, it certainly would not have been opposed in contrary position." Here he teaches much in a few words, to those who can understand his writings. Thence, perhaps, it would have been just, that we, who admire other excellencies of this Author, should also admire this, namely, that he can teach much in few words. The manner of explaining every thing that has been written by him, having been demonstrated, it is not necessary further to particularize his words. For as Hippocrates did not thoroughly understand this subject, and only incidentally alluded to it, we have resolved to recount the use of all parts, as soon as we have explained that one alone, of those writings, which Hippocrates has demonstrated in the preceding discourse. But this very thing, no one can find out, unless he diligently considers the use of parts. What then is this one thing? That we may know what is the best formation of the human body. It is evident, it is that construction which possesses, within itself, all the parts necessary for the fulfilment of its functions. For he says, it is an advantageous disposition of the fingers, that that should be the long one which is in the middle, and that the thumb be opposed to the index finger. If you ask wherefore? you have at once this written answer:—That the body is so constituted that

all parts consent and harmonise ; and the parts of each organ, to the functions of that organ. What, therefore, is the action of the hand ? Doubtless, prehension. How, therefore, would all the fingers have combined to this end, unless the long finger were placed in the middle, and the thumb opposite the first finger ? In this manner, all actions by these will be properly performed. Therefore, when you investigate the advantageous disposition of the eyes or the nose, you will find a construction suiting the purposes for which they were formed. For this very construction will afford you a rule, a measure, and a criterion to discern advantageous disposition, and true beauty. For true beauty is nothing else than the most excellent construction, which, according to Hippocrates, you will examine and judge of by its actions ; for true beauty is shewn, neither by fairness, nor softness, &c. for of this kind is cosmetic, and counterfeit beauty ; for the dealers in women in the East would praise one description, and Hippocrates another. You, perhaps think that Socrates spoke in jest at the house of Xenophon, when disputing concerning beauty, with those persons, who, in his time, appeared the most beautiful. But if he spoke ingenuously, he would not refer to the action, and thus would consider all beauty, perhaps, as if only in joke. But since, in the whole of that discourse, he refers the beauty of the construction of the smaller parts, to

the excellence and power of action, it is by no means to be considered that he was only in joke, but that he spoke in earnest. For this was the habit of study and industry of Socrates, always to mingle serious subjects with jokes. We have spoken sufficiently on these subjects, both to demonstrate the usefulness of the present case, and of the subject proposed, and to point out the manner in which we must receive the opinions and sayings of the Ancients. Let us, then, pursue the whole construction of the hand, leaving nothing, as far as we are able, untried or unexamined. But that we may proceed with our discourse in a proper method, let us mention every thing in the body ; first, and principally, are the combinations, (temperaments,) for these complete the proper substance of the parts. For because the body is thus [constituted] of heat and cold, of dryness and moisture, from this circumstance, it is such by nature. For this has been formed from a certain incorporation of the above mentioned four, for muscle to be muscle, for nerve to be nerve, and for each of the rest, whatsoever it may be ; and these are in them, according to the intended use of the substance. But the odors, tastes, colors, hardness, and softness of parts, are necessary consequences ; there are other properties that necessarily follow, position, magnitude, connexion, and formation. As often as you examine organs with accuracy, you must

diligently examine their use ; in the first place, the cause of action, which cause you will find in the proper structure of the parts. It is the case, when function results from particular construction of the organs, as the eye, for vision. Then you must examine each separate part of the eye, if the part be useful, on account of that particular function, or on account of some properties which are the result of the temperaments, as bone for its hardness. After this, you must examine all the circumstances that are to be found in the entire organ, and of the part of which it is composed ; which are, as above mentioned, position, magnitude, connexion and form. But whoever supposes that he has correctly examined the use of parts before he has examined all these, both in a healthy and morbid condition, is the subject of delusion. In order to avoid falling into this error, we will commence with the hand, as we proposed to describe it the first, and afterwards we will examine each of its parts, in all the circumstances as we before taught. As the action of the hand is prehension, it would not be possible to take hold of any thing, if the hand was incapable of motion, it is evident it would resemble a hand cut out of stone, or a hand that was dead. Because the principal part of its action will be in that part by which it is moved. Then since we have shewn that all voluntary motions (as those in the hand) are performed by

muscles, the hand will be endowed with these, as the principal instruments of motion. But as to all the other parts, some have been formed to improve the action, others, because it was impossible to produce action without them, and the rest were created for the protection of the whole. For this reason, nails have been formed, because it was better, for the hand could seize without nails, but not bodies of every size, nor so well as with them. We have demonstrated, that hard and very small bodies, easily escape them and slip away, unless some hard substance resist, at the tips of the fingers, to support the flesh at this part. Thus far, the use of the hardness and position of the nails has been described. But why are they made so hard, and no harder, and why round on every side, has not yet been mentioned; and now is the proper time to state this. If they had been harder than they are at present, they would have resembled bone, and thus less suitable for prehension, as they could not have been bent in the least; and like all other hard bodies, would easily have been broken. Therefore nature providing for their safety, has made them moderately hard, so as neither to impair at all the use for which they were made, nor to render them readily obnoxious to injury. And that nature so provident, made them so much softer than bones, so far as by yielding moderately they escape from, and

deaden the violence of, external bodies that strike them forcibly. The construction of all similar parts may show you. She has formed all prominent and exposed parts of animals of such a density, as neither to be easily crushed on account of their softness, nor broken on account of brittleness. Such is the composition of hoofs—solid as well as bifid ; such are the spurs of birds, and such is horn. Which, so far as they are defensive weapons, and it was necessary for them to be so much harder as they are, by which means they could bruise and cut in a greater degree. But for their own safety it was not better for them to be made so hard as to be easily broken. Thus, therefore, we say that sword is the best, which is not made of brittle steel, as they are principally amongst the Indians, although they cut the best : but that sword which is tempered to such a degree of hardness, as not to be broken easily, and to cut readily. Therefore the parts of the body which are strong, and which answer to defensive weapons, are indeed harder than the coverings of the body, but not so much so as to be broken. But those parts which are not arms, but simply parts of the body, it was necessary they should project and be prominent, (as the ears, the nostrils, the elbow, and the knee :) they have been formed of a softer substance, that, being more yielding, they more easily avoid external injuries. Such also are the nails of men ; and on this ac-

count have been made much softer and thinner than the claws of wolves, lions, and panthers. For the organ of a domesticated animal, and governed by laws, has been constructed for perfection of prehension, not for the defensive arms of a wild beast. Why are they round? Is this also for their safety? For the round figure alone has been exquisitely formed for easily avoiding injury, as being that, which has no angle projecting liable to be broken. But since in scratching, or other actions with nails, it was necessary for us that their extremities should project, nature has constructed these parts alone of the animal capable of constant growth, although the entire body has ceased to grow. They do not grow as other parts, that is in length, breadth, and depth; but in length only, after the manner of the hair, the new nails constantly growing from below, and thrusting the old before them. Nature has not ordained these things idly—that there may always be sufficient length of nail projecting. Thus the providence of nature extends to the nails of the fingers. From these things, you easily learn the kind of bones in the fingers, and these very bones have been formed for the sake of greater utility. For they could easily have been moved without bones, as in the polypi; but without the hard and resisting parts, we could have had no firmness of action. Such is the use of bone in the human body; and for that reason has been formed in the

fingers, in the hand, the legs, and the various parts of the body. Therefore, the effect produced in each of the other organs, by the firmness caused by bones, the following discourse will point out. You may perceive, that the same firmness is useful to the fingers in many actions, if you take into consideration that we should by no means write, nor dissect, nor perform any similar thing, without bones, better than they who are affected with tremor. For that tremor, which is the effect of disease in them, would constantly be inherent in all of us by nature, as long as the fingers could be twisted, and as it were shaken by reason of their softness. But the nature of bone has been given to this end by the Creator, supporting and strengthening the fingers in every position. But this very circumstance—to be capable of assuming many positions (because it would be the most useful)—is derived from this, that each finger has been composed of many bones, which could not have been the case if composed of one only ; for then those actions alone would have been well performed which required extended fingers. And here we must admire the art of nature, who has formed the fingers suited to all actions. If they had been formed without bones, they could only have performed those actions well, in which it was necessary to apply them in a circle round the object to be seized. If formed of one bone only, they would

have been useful in those actions only, which required extended fingers. And because they have been formed neither without bone, nor with one bone alone, but that each finger has been formed with three bones, connected to each other by separate joints, on this account they are formed for every action. For all the joints being bent, we close the fingers as if made without bones ; but when extended, as if the fingers consisted of a single bone. But generally, it is not required that all should be extended, nor all bent ; sometimes the first joint only, or the second, or the third ; at other times extending or bending the first and second at the same time, or the second and third, or the first and third ; in this manner we form six different figures. They form six varieties of position in the fingers ; and it is impossible to state, but easier to conceive, to how great a number the differences of greater or less flexion or extention in each variety are multiplied. For perfect extention, as well as flexion, is indivisible into greater and less. But the motions of these articulations intermediate between the six varieties, at one time more, at another time less, bent or extended, form an infinite number. Therefore, not only six varieties of position are first formed in fingers thus constructed, but six in general, the separate varieties are infinite. With regard to the other two constructions, the one without bones is capable of assuming the

circular form only ; and the other, consisting of a single bone, can only form a right line. In the present construction, the fingers have not been deprived of these two ; and, in addition, have acquired six positions in general, and a great variety in particular. It was possible for fingers, consisting of single bones, to form first an exactly straight line, since they had been arranged in a straight figure ; and it was by no means possible to form a circle. Certainly for this reason, nature has contrived the creation of flesh as a remedy, which it was not necessary to cause to grow on the external parts of the bones, for it would thus have been a superfluous burthen. But she caused it to grow below, on all the inner parts, in order that when it was necessary to clasp any spherical body, the softness forming a construction, and easily yielding to bodies which meet it, rectifies the straightness of the bones. For this reason, nature has formed the smallest quantity on the joints themselves, and the greatest quantity on the parts between them. Nor did any joint require such an assistance from the flesh as was necessary for the bones, since the joint was formed to be bent : the flesh loading the part superfluously, and obstructing the internal space, would have been an impediment to motion. For these reasons nature created the flesh ; none on the outside of the fingers, the greatest quantity in the inside, on the parts be-

tween the joints, and the least of all on the joints themselves. Nature has placed on the sides of the fingers so much flesh as would fill up the vacant interspaces, so that the hand should not be an organ merely divided into many parts, but that it should be able to act as if undivided. When the fingers are placed side by side close to each other, the whole of the intervening spaces are so closed by the flesh, that after placing the hand supine, to prevent the fluid flowing off, you can hold any fluid. Such and so great are the advantages derived by the hand from the flesh; and in addition to these, to soften and rub gently whatever requires soft instruments to soften and rub them; there are many such in all arts. These are the peculiar uses of the flesh in the hand; and the common uses (for the hand derives no less benefit from them) will be described in a work by an author who has written upon the subject. Plato says, in his Timaios, "that the flesh is a defence against heat, a protection against cold, and falls, yielding softly and gently to opposing bodies, as a covering made of wool. And the flesh, containing a warm moisture, perspires and becomes moist in summer, and produces an external cooling suited to the whole body; on the other hand, during winter it resists, to a certain degree, by this heat, the cold that attacks and surrounds it externally."

There is no occasion for further argument, to show

*"Αφροδισιας" Opifex is applied to
Theophilus & the Divinity. It is not
of Christian origin it occurs in
"Galen" and in the Similes of
Plat.*

that the flesh is a defence resembling a covering of wool. And it is likewise evident, that it contains within itself a warm moisture from the blood ; and that all moisture of a moderate warmth, such as in flesh, is a defence against both extremes of heat and cold. The generality of persons do not agree on this subject ; but they would quickly be persuaded, if we first reminded them of the effect of baths ; we should then explain the nature of the fact.—You can find nothing that will more rapidly cool persons oppressed with extreme heat, nor more readily warm persons suffering from extreme cold, than the bath. The bath being fluid, and of a moderate temperature, moistens, by its fluidity, the dryness caused by heat ; and by its warmth, relieves the coldness produced by a low temperature. These observations on the flesh of the hand are sufficient. Let us return to the description of the nature of the bones and joints, from which we digressed. It has been sufficiently demonstrated, that we require these for steadiness in their actions, and for a great number of positions, on account of the numerous variety in the forms of prehensible bodies. We have not yet said any thing concerning their number, why so many, and the individual size of each particular bone, why so large, and on the form and method of their articulation. Therefore, let us again point out the necessity of the bones of the finger

neither exceeding, nor being fewer than three. Had they exceeded three, the performance of any action would not have been improved; for all actions have been proved to be performed to perfection by three bones; and it would have impaired perfect extension, by rendering it less steady than at present. For fingers, that consisted of a greater number of divisions, would more easily give way, than fingers composed of fewer. And if formed of a number smaller than three, they would not have been capable of assuming so great a variety of separate positions: therefore, in order to be able to perform a great variety of movements, and to avoid liability to injury, the number three is the most excellent. And it is self-evident, that the preceding bone, must exceed in magnitude, the bone it supports. The one carries, the other is carried; and it was necessary that the one carrying, be larger than the one carried. And we have already proved, that it was necessary for the tips of the fingers to have a tapering and round termination. And it was impossible to be otherwise, since the magnitude of the bones diminished gradually; and, for this reason, the second bone must always be smaller than the preceding. And concerning their shape, that each bone terminates in a broader base above, and a narrower apex below. And this conformation of the ends of each bone, will endow it with the advantages mentioned, when

speaking of their magnitude. We must show they were round, to avoid liability to injury ; for of all forms, that is the most difficult to injure, because there is no projection that can be broken off, by external bodies striking against it. And why is each bone exactly convex externally, and not at all so laterally and internally ? Was this ordained for the best ? The fingers both rub, and soften, and take hold of all things, with their internal parts : and these actions would have been worse performed, if the bones had been formed convex in this part. And externally, they have been constructed accurately, to avoid injury only, not executing any of the above, not any other action, with this part. Laterally, they defend each other, to render them difficult to injure, and, when placed in conjunction laterally, they required that no intervening space be left vacant ; therefore it was by no means necessary, that they should be made convex here. And the conformation of the thumb and little finger, proves what has been mentioned, the one having its circumference exactly convex superiorly, and the other inferiorly. For in this part, they are not protected by any finger, nor do they touch any finger. And this wisdom of nature, in the construction of the bones, is truly wonderful ; and the mode of articulation, is no less worthy our admiration. For not simply, and as by chance, has each of the fingers been formed of three bones,

but as in hinges of a door, so in the joints, each articulating surface is formed with convexities, fitting into the depressions of the other surface. This, perhaps, is not so wonderful, for when you have examined the joints of all the bones of the whole body, you will always find the prominences, equal to the depressions which receive them : this will appear to you most wonderful ; for if the cavity had been too large, the joints would have been loose and weak ; if too small, the motion would have been difficult, there being no room to move ; and there would have been no slight danger, that the prominences of the bones, being straitened for want of room, would have been broken off ; but none of these accidents occur. But since, from so secure a construction, there was danger that the motion would be too difficult, and that the prominences of the bones be worn away, nature obviates this by two means. In the first place, she has covered the ends of the bones with cartilage, and has also poured out on these cartilages, a certain unctuous viscid fluid, by which, the entire articulating surfaces of the joints are made to move easily, and without friction. Nature's contrivance of the rims about the cavities, was sufficient to prevent dislocation of the joints. She has not entrusted the security of the joints to this alone, since she foresaw that the animal would be often exposed to many forcible and violent movements. Therefore, in order that all

articulations be carefully protected on every side, nature has caused certain ligaments to arise from the one bone, and pass to the other. Some like round cords, others like prolonged thin membranes ; and they have always been formed so as to correspond to the use of the joints. The largest and thickest to protect the largest joints ; the less guard the less important and minor joints. Ligaments are common to all joints, and nature has constructed them according to each joint, and she has formed those of the fingers in the best possible form. The articulating surfaces are, indeed small, and accurately formed, but carefully crowned, with small convexities covered with thin cartilage, and finally bound together with ligaments. Nor are these convexities placed exactly on the top, for the external part is placed higher, and the internal lower ; great is the care of nature in the construction of the fingers. If the external part were low, it would allow the articulation to be bent beyond the straight extension, and if the inside were high, it would prevent them from being much flexed ; they would have been injurious on both sides, by destroying the steadiness of extension, and allowing flexion backwards, instead of internally. But since they are formed to the contrary, they are the cause, not only of no injury, but of every advantage in the motions of the fingers. Why are the bones of the fingers solid, hard, and marrowless ? Is it because

they are uncovered, and therefore liable to injury? In the liability to injury, from the want of external covering, one very great advantage is, the property of not being very sensible of pain in their peculiar construction. This is the state of the bones of the fingers, and I will now pass on to the state of the other parts; in the first place, bearing in mind, as has been demonstrated, that it is not possible, for the use of a part to be properly found out, before its action be known. It is apparent, and granted, that the action of the hands is prehension, and it requires no further demonstration. But men do not agree, nor is it evident concerning the actions of the arteries, the veins, the muscles, and the tendons, and for this reason a longer discourse is required. But it is not now the proper time to inquire into these actions. We do not now propose to discuss their actions, but their uses. It is, therefore, necessary thus to complete this discourse, by receiving as principles the conclusions, from the demonstrations made elsewhere. Because the brain and spinal cord are the origins of all the nerves; and again, as the brain is the origin of the spinal cord, and the heart of all the arteries, the liver of the veins. And it has been demonstrated by dogmata, in the works of Hippocrates and Plato, that the nerves derived their animal power from the brain, and the arteries their pulsation from the heart, and that the veins receive

their properties from the liver. Therefore the use of the nerves will be to transmit sensation and motion from the origin to each part separately ; and the use of the arteries to maintain the heat according to nature, and to nourish the vital spirit. The veins were formed both for the formation of the blood, and also to convey it to all parts of the body. How tendons, nerves, and ligaments differ, has been mentioned in the observations on the actions of muscles. And it is evident, that the nature of muscles has been there described, and that they are the organs of voluntary motion, and that their terminations are named tendons. Therefore, bearing in mind former conclusions, from the demonstrations, we shall describe the use of them in each of the organs, beginning again with the fingers. Nature has constructed the bones in the best possible manner in these organs of prehension ; yet it was impossible for these bones, that resemble earth and stone, to contribute to motion as regards the first movement ; it was, therefore, for her to find out in what manner, she could move them by other means. Therefore having caused tendons to arise from the muscles of the arm, she led them direct to the fingers. For those which are named nerves by the Ancients, are very distinct ; those that move the fingers are tendons, and arise from the tendinous fibres dispersed among the muscles, and that are united ; but their use is according to

the nature of their composition. For they possess sensibility, are moved by voluntary motion, and connect the muscles to the bones ; the first two of these, they derive from the nerves, the latter, from the ligaments. As a ligament being white, bloodless, and solid, resembles a nerve, it consequently appears to many of the unlearned to be a nerve. But it does not arise from the brain, nor from the spinal cord, but it extends from bone to bone, and is much harder than a nerve, and is entirely destitute of sensibility, and is able to move nothing. Therefore, nature having extended all those tendons, that appear at the carpus, from the muscles of the fore arm to the fingers, has fastened them to each of their joints, not into the very junction of the bones. For it would have been in this manner useless. Nor into the end of the bone that is placed before the joint (for that would not have been advantageous) but into the head of the second of the bones, which is to be moved. I think as, images are wont to be moved by strings. For in these passing beyond the articulation, they apply the string to the nearest end of the parts placed below, so that the string being pulled above, the limb easily follows. And if you have ever clearly seen, what I tell you, you already understand how each of the joints of the fingers is moved by the tendons. For the bone that is placed above, remaining fixed, each of the bones placed beyond, is extended, when the tendon situated externally is

pulled, but when the internal tendon is drawn, the finger is bent. Why then were the tendons formed long, and why were not the muscles prolonged to the carpus? Because it was better that the hand should be light and slender, and not encumbered with a load of flesh; and at the same time, it would have been both heavy and thick. For the hand would thus have performed many of the things worse, and more slowly, which it now performs both readily and well. But as no flesh of itself possesses sensibility, and it would have been unreasonable that the organ of prehension should have been without the sense of touch, nature has distributed no small proportion of nerves to the integuments. But at present, let us recall to our minds, the actions of the thumb, before mentioned, in which it was demonstrated, that when set in opposition, it supplied advantages equivalent to all the four fingers combined. When men revolve these things in their minds, they seem to name this thumb *antichair*, as if it were an opposing hand. For they perceive that the actions (of the hand) are similarly destroyed in those persons, whether the four fingers have been cut off, or this thumb only; and thus, if half the thumb be destroyed, in any way, the hand will experience a disadvantage, and impaired action, equal to a similar injury to all the fingers. Therefore, O ingenuous sophists, and skilful accusers of nature, have you ever contemplated this thumb in the monkey, which

many men name anticheir, and Hippocrates names megan? or, if you have not contemplated it, dare you affirm that it in every respect resembles the thumb in man? And assuredly, if you have ever contemplated it, it is proved to you to be short, slender, crooked, and indeed excites laughter; as also the whole animal excites laughter. Some of the Ancients, reminding us that this animal is a ridiculous amusement for children, say, the monkey is always amusing with children; for it attempts to mimic all the actions of men, and is foiled in these, so as to excite laughter. Or have you not seen an ape attempting to play on the flute, to dance, and write, and any other action that man performs well? What does it look like? Does it resemble us? Or does it attempt all of these in a ridiculous manner? Perhaps you may be ashamed to say it is otherwise? And assuredly, O most sapient accuser, Nature would tell you, that a ridiculous mind having been given to an animal, it was necessary that the construction of its body be ridiculous. Therefore, the ensuing discourse will point out, in what manner its whole body is a ridiculous mimicry of man. If any painter or sculptor, when copying the hands of a man, intended to commit a laughable error, he could not in any way fail, if he imitated the ape's. We laugh the most at those imitations that preserve with fidelity the likeness in the greatest number of parts, but in the most important, greatly fail. Therefore, what advan-

tage do they possess, in having four fingers well constructed, if the thumb be badly constructed, so that it is not worthy to receive the name of thumb? And assuredly, it is such in the ape; and, in addition to this, is altogether ridiculous, and is situated a short distance only from the index finger; so that, perhaps in this, Nature is just, as Hippocrates is often in the habit of naming her, having invested the ridiculous mind of an animal in a ridiculous body. And Aristotle properly points out, that all animals have been arrayed in suitable forms; and he endeavours to point out the skill in each. But they do not act justly, who neither perceive the attributes of other animals, nor of that animal, which is the best constituted of all animals, but maintain a great contest, and are afraid, that they should in any way be shown, either that men possess a soul wiser than senseless animals, or a construction of body suitable for a wise animal. Let us now leave these persons: but when I have added what is wanting to complete this book, both of the use of the number, and of the unequal length of the fingers, I shall come to a conclusion. But this is not difficult for us to discover, if we consider the advantages, we enjoy by the assistance of the fingers; for had they been fewer, many actions would have been executed more imperfectly; and, if more, in no action were they required. Therefore, you will easily learn, by following each in the description, that if they had been fewer, they would have performed

many actions with diminished power ; for if the thumb were lost, the power of the fingers would cease ; for, without this, none of the fingers can perform anything properly. Of the remaining fingers, the index and middle finger, as they are the second in position, after the thumb, so they happen to be in point of utility. For the taking up of all minute bodies, and nearly all works of art, and if it be necessary to use any force, all of these seem to be required ; but that after the middle finger, and the little finger, give less assistance than the others. But that use of them, clearly appears in those cases, in which we want to seize an object of a spherical form. And if the object be pulpy or small, it is necessary the fingers be bent, compressing it on every side ; perhaps the little finger is the most useful in this case, as it were, completing the circle ; but the index finger is the second in strength. If a hard, or large body be seized, we must seize it in this manner, having separated the fingers from each other, as much as possible ; and in this it is better that a greater number should encircle (the body,) coming into contact with it in a great number of parts. But I think it has been already mentioned, that in actions of this kind, that the lateral motions of the fingers are of great use ; the thumb being placed internally, and all the others being arranged in a circle on the outside. For thus it happens, that the body is contained in a circle on every side, and if in a circle,

it is evident that a greater number would be superfluous : and five are sufficient for this, and Nature creates nothing in vain ; for it was equally her care, that nothing be deficient, and to create nothing superfluous ; for a defect in construction, shows also defective performance. And a superfluity will be an impediment, in the parts that act independently, imposing an extraneous burden, and, for that reason, it is injurious : and the person to whom nature has assigned a sixth finger, bears witness to this description. And why were they all formed of unequal length, and the middle finger the longest ? Because it was better that their summits should come to a level in seizing any body of large size in a circle, and in attempting to hold any thing pulpy or small in them. For in bodies of greater bulk, an equal grasp on every side greatly assists, both in order to retain them firmly, and to hurl them with violence. The five fingers evidently extend to the circumference of a circle in actions of this kind, most especially where they encompass a body exactly spherical ; for in these, any one may very clearly understand, what happens in other forms of bodies, but it does not appear equally evident, because the extremities of the fingers opposing each other with equal force on every side, make their grasp more secure, and their hurling more violent. As I think also in triremes, the extremities of the oars, reach an equal surface, although they are not all of equal

length ; for they make the middle oars of the greatest length, for the same reason. In closing the hand, or when we wish to hold exactly a small body, the inequality of the fingers affords a very evident advantage. I think that it has been demonstrated in the former description, where I demonstrated, that the thumb placed upon the index finger, formed as it were, a cover to the interspace. But at the present, briefly adding a few more words, I hope that I shall point out every thing ; for in actions of this description, if you had pictured in your own mind, and had contemplated the effect of the little finger being made longer, or any of the middle fingers shortened, or the thumb, which is placed in opposition to the fingers, to have occupied another position, or to have been of a different size, you would know, surely, in how great a degree the present construction is the best. And the actions of the fingers will consequently sustain very great injury, if the slightest change were made in the present arrangements : for we can take in our hands, both large and small bodies, and can hold any fluid ; we should not handle these properly, if the size of one of the fingers be altered ; by which it is evident, how great a degree of accuracy this present construction has attained.

THE END.

